

REMARKS:

Reconsideration and allowance are respectfully requested.

The specification has been amended to incorporate the proper headings under rule 37 CFR 1.97 and to correct any typographical errors.

The drawings stand objected to for having two Figure 3 illustrations. The top Figure 3, admitted as prior art, is now labeled as Figure 7 and this change has been incorporated into the specification. A corrected drawing sheet for Fig. 3 and new Fig. 7 is attached hereto and labeled "replacement sheet".

Claims 1-6, 12 and 15 stand rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 3,763,650 (HUSSEY et al.). Accordingly, claim 1 has been amended to further define the structure which achieves the invention and to distinguish the present invention from the cited references. Claims 2, 4 and 10 have been cancelled.

The present invention is directed to a fuel injector nozzle for a gas turbine. A combustion chamber is coupled to a conduit 2 wherein air flow 5 is guided by the air flow conduit 2 and then passed through a diffuser 4. The diffuser 4 forms the air flow into an annular ring air flow which is presented to the fuel injection nozzle 6 comprising swirl vanes 7 for creating air flow vorticity and turbulence to allow intermingling with the fuel from the injector portion 8 (Page 3 line 29 to Page 4 line 6; Figs. 1 & 3). The nozzle has a greater cross-section than the annular ring air flow such that the outer regions of the nozzle 6 has lower pressure than the direct impingement region wherein the direct impingement region is identified as the region between air flow broken lines 5 identified in Fig. 1. The fuel injector nozzle 6 includes a fuel distribution arrangement 47 comprising fuel distribution structures asymmetrically distributed about the nozzle 6 in order to differentially present the fuel to the air flow. More fuel is distributed to the region of direct impingement and less fuel is distributed to the outer regions of the nozzle (Page 4 lines 22-24; Fig. 5). Specifically, the fuel distribution structures asymmetrically distributed about the nozzle differentially present fuel to the air flow passing through the nozzle and are dependent on localized air flow pressure as claimed in currently amended claim 1.

HUSSEY et al. is directed to an axial flow gas turbine having a structure including a fuel nozzle for providing a desired turbine inlet temperature profile according to the mechanical stress on the rotating turbine blades (Abstract). The invention granted to HUSSEY et al. is directed to provide a more efficient use of the rotor blades 18 by varying the initial input gas temperature profile inversely to the centrifugal force stress profile from varying the fuel nozzle features so as to provide desired fuel distribution patterns (Column 3 lines 35-45 & Column 4 lines 50-55).

A multi-stage axial flow compressor 12 supplies air under pressure to the combustion apparatus through a plenum chamber 13 which then feeds the air to the turbine through a plurality of circumferentially spaced transition members 14 (Column 3 lines 4-16). It should be noted that there is no disclosure of the air flow having a lower pressure region or a direct impingement region as in the present invention. Indeed, HUSSEY et al. discloses air under pressure is supplied through conduit 36 into an atomizing fluid supply passage 37 extending through the nozzle body wherein the pressure of the atomizing fluid is controlled by a valve 39 which can be varied according to the rate of the supply of fuel (Column 4 lines 34-45). It seems HUSSEY et al. aims to supply air to the injector at a constant pressure around its circumference due to the large volume of the plenum chamber 13 and the directional change to the air flow.

The air flow of HUSSEY et al. is not disclosed as having passed through an upstream diffuser in order to present the air as a flow that has direct impingement on the nozzle. More specifically, HUSSEY et al. does not teach or disclose the nozzle having a greater cross-section than the air flow directly impinging upon the nozzle so that air flow passing through the nozzle has portions of lower pressure outside the direct impingement region.

Since HUSSEY et al. fails to teach or disclose (1) the fuel injection nozzle having a greater cross-section than the air flow directly impinging upon the nozzle wherein the air flow passing through the nozzle has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on

the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over HUSSEY et al.

Claims 1-6, 12 and 15 stand rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,267,442 (CLARK). As discussed above, claim 1 has been amended in order to further distinguish the present invention from this reference. CLARK discloses an improved fuel nozzle for attaining improved ignition of the combustor in gas turbine engines. Referring to Fig. 1, liquid fuel is presented to fuel nozzle 24 wherein the improved fuel nozzle spreads the fuel within dome 16. The nozzle 24 is better illustrated in Fig. 3a wherein three passageways are provided within the nozzle 24 in order to allow the fuel to pass and be ejected from the nozzle into the dome region. CLARK'S nozzle is directed to spread the fuel more appropriately than the prior art nozzle shown in Fig. 2a. The air flow presented to air swirlers 26 and 18 is not disclosed or taught anywhere in the specification. More importantly, CLARK fails to teach or disclose the nozzle having a greater cross-section than the air flow. Furthermore, there is no indication of an air flow passing through the fuel nozzle and thus no air flow could possibly directly impinge the fuel nozzle. Contrast to the present invention, the air flow of CLARK does not pass through the interior of the nozzle but is swirled circumferentially about the nozzle at its ejection end.

Since CLARK fails to teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over CLARK.

Claims 1-6, 12 and 15 stand rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 6,813,889 (INOUE et al.). Accordingly, claim 1 has been amended to further distinguish the present invention from this reference. INOUE et al. discloses a combustion chamber into which fuel and air are supplied as a plurality of coaxial jets (Column 1 lines 33-43). The fuel nozzle body is

divided into central fuel nozzles 56 and surrounding fuel nozzles 55 (Column 4 lines 20-23; Fig. 4a). Air 50 is supplied by a compressor 10 under constant pressure wherein a portion of the air 50 is flowed into the combustion chamber 1 as cooling air 31 for the combustor liner 3 and the remaining air is flowed into the combustion chamber as coaxial air 51 from the interior of inner cylinder 2a through holes 52. Specifically, INOUE et al. fails to teach or disclose the fuel injection nozzle having a larger cross-section than the air flow directly impinging upon the nozzle.

Since INOUE et al. fails to teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over INOUE et al.

Claims 1-6, 12 and 15 stand rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Publication 2003/0106321 (VON DER BANK). As discussed above, claim 1 has been amended to further distinguish the present invention from this reference. VON DER BANK discloses a lean premix burner for a gas turbine having additional secondary fuel nozzles 9 beside primary fuel nozzles 8 within a fuel supply ring 4 (Page 1 paragraph 12). The air-to-fuel ratio in lean premix burners is known to be set high so as to realize a very lean mixture which results in relatively low burning temperatures in the main burning zone (Page 1 paragraph 6). The primary fuel nozzles of VON DER BANK are distributed evenly around the circumference of the fuel supply ring 4 and the secondary fuel nozzles are distributed unevenly around the fuel supply ring 4. The additional secondary fuel nozzles allow the fuel-air mixture to be enriched at local points around the fuel supply ring 4 which ensures higher-temperature combustion at the flame root creating a more stable flame without the need of additional pilot burners (Page 1 paragraph 14).

VON DER BANK also discloses an internal staging of fuel feed flow around

the fuel supply ring 4 wherein the invention switches and controls the fuel feed. During low load operating levels, additional secondary fuel nozzles are switched on while other primary fuel nozzles that are not needed are switched off. When switching over to full load operating levels, a continuous rise in the fuel mass flow is ensured by switching the primary fuel nozzles on while switching off the secondary fuel nozzles that are no longer required (Page 1 paragraphs 15-17).

The invention is thus intended to (1) facilitate a richer air-fuel mixture at local points around the fuel supply ring, (2) to realize a higher level of flame stability so that additional pilot burners are not required and (3) to facilitate a continuous transition from full load operating levels to low load operating levels while keeping the same amount of total fuel flow being supplied to the burner (Page 1 paragraphs 19-21).

While air flow is presented to the nozzle in VON DER BANK, there is no mention as to the air flow's pressure and distribution at any point in the specification. Indeed, the air flow is not discussed at all which implies the air flow's pressure and distribution are not an issue to VON DER BANK. More importantly, VON DER BANK fails to teach or disclose the nozzle having a greater cross-section than the air flow directly impinging upon the nozzle. It should be noted that, from the illustration of Figure 1, it appears as though the nozzle ring 4 is smaller in cross-section than an air flow presented to it.

Since VON DER BANK fails to teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over VON DER BANK.

Claims 4-6 and 12 stand rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 5,545,033 (DICK et al.). Claim 1 has been amended to overcome this rejection. DICK et al. is directed to oxygen-fuel burners intended to be arranged in a furnace wall, such as a glass furnace, or low-impulse burners

operating with relatively low gas outlet velocity (Page 1 lines 3-7). Thus, the invention granted to DICK et al. is intended to a fuel burner for a furnace rendering the invention not applicable for a gas turbine as claimed in currently amended claim 1. The main focus of DICK et al. is in the distribution of the gas deliveries in the same cross-section of the burner such that the ratio of the oxygen to gas being delivered is markedly below the stoichiometric value (Column 1 lines 23-31).

Since DICK et al. fails to teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over DICK et al.

Claims 2 and 3 stand rejected under 35 U.S.C. 103(a) as being unpatentable over any of the above art and in further view of the admitted prior art discussed at Page 1 last paragraph in the specification. Regarding this rejection, each of the above prior art has been distinguished from the present invention from the above arguments. Claim 2 has been cancelled and claim 3 has been amended to better clarify the invention as claimed and is dependent upon already distinguished currently amended claim 1.

It is to be noted that while it has been admitted by the applicant that wider cross-section air/fuel swirler arrangements are well known in the art, it is contented that the effect of the larger cross-section of the nozzle on the quality of fuel distribution caused by the presented area of air flow is not recognized in the prior art. Accordingly, even though some references disclose an asymmetric fuel distribution technique, none of the above references teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure as claimed in currently amended claim 1.

Claims 1-6, 12 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,799,872 (NESBITT et al.) in view of any of VON DER BANK, CLARK or HUSSEY et al. Claim 1 has been amended to further distinguish the present invention from the cited prior art. NESBITT discloses a main injector 10 and a pilot injector 12 (See Fig. 1). The main injector is operated during high load levels, such as take-off, and is shut off when the high power requirements have been met. Conversely, the pilot injector is in continuous operation while the gas turbine is operated. High pressure air, supplied by the compressor, is present in the air plenum 24 (See Fig. 4) and supplied via the injector of the invention to the combustor 22. The compressed air, of uniform pressure, flows through the air channel 92 wherein fuel is presented to the air by discharge orifices 80, 90 (Column 6 lines 11-20). Thus, the air of NESBITT et al. is under constant pressure and therefore does not have portions of lower pressure outside direct impingement.

Since NESBITT et al. fails to teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1, the present invention is believed novel and inventive over NESBITT et al. in view of any of VON DER BANK, CLARK or HUSSEY et al.

Even if any, or all, of the above references were combined, a person of ordinary skill would still not be able to obtain the present invention since none of the prior art teach or disclose (1) a fuel injection nozzle having a greater cross-section than the air flow presented thereto wherein the air flow has portions of lower pressure outside of the direct impingement region and (2) differentially presenting fuel to the air flow passing through the nozzle such that the fuel presented is dependent on the localized air flow pressure, as claimed in currently amended claim 1.

Having addressed all the points raised in the action, entry of this amendment is solicited, is believed appropriate, and is believed to distinguish the

invention from the cited references. For the foregoing reasons, reconsideration and allowance are believed in order and are solicited.

Respectfully submitted,

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